

**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, DC 20554**

In the Matter of	)	
	)	
Expanding Flexible Use in Mid-Band Spectrum	)	GN Docket No. 17-183
Between 3.7 and 24 GHz	)	
	)	

**REPLY COMMENTS OF WI-FI ALLIANCE**

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November 15, 2017

## TABLE OF CONTENTS

I.	INTRODUCTION AND SUMMARY .....	1
II.	THE ENTIRE 6 GHZ BAND SHOULD BE AVAILABLE TO UNLICENSED OPERATIONS.....	4
A.	Spectrum Scarcity Requires the Allocation of the Maximum Amount of Unlicensed Spectrum Possible.....	5
B.	The Scope of Uses of Unlicensed Spectrum Has Expanded.....	7
III.	UNLICENSED OPERATIONS CAN SHARE SPECTRUM WITH INCUMBENTS.....	9
IV.	A PROPOSED FRAMEWORK FOR INCUMBENT PROTECTION.....	12
A.	Classes and Bands Summary .....	13
B.	Devices and Mitigations. ....	14
1.	Indoor Access Points and Other Fixed Indoor Devices .....	14
2.	Client Devices.....	15
3.	Low Power Outdoor Access Points. ....	15
4.	Outdoor Access Points and Fixed Point-to-Multipoint Devices.....	17
5.	Fixed and Steerable Point-to-Point and Outdoor.....	19
C.	Satellite Operations.....	20
D.	Adjacent Band Protection - Emission Limits.....	20
E.	Additional Database Considerations.....	20
V.	OTHER MATTERS RAISED BY COMMENTING PARTIES SHOULD NOT DELAY DESIGNATION OF THE 6 GHZ BAND FOR UNLICENSED USE.....	21
A.	Illegal Modification of Wi-Fi Devices.....	21
B.	Undesirable Emission Limits.....	22
C.	Use of DFS Bands.....	23
VI.	THE COMMISSION SHOULD ISSUE AN NPRM FOR THE 6 GHZ BAND QUICKLY.....	23
VII.	CONCLUSION.....	24

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Wi-Fi Alliance®<sup>1/</sup> submits these reply comments in response to comments of other parties in the above-referenced proceeding in which the Commission seeks input on potential opportunities for additional flexible access, particularly for wireless broadband services, in spectrum bands between 3.7 and 24 GHz.<sup>2/</sup> The record supports Wi-Fi Alliance’s request that the Commission act quickly to propose unlicensed operations in the entirety of the 5.925-7.125 GHz band (the “6 GHz band”).

**I. INTRODUCTION AND SUMMARY**

Wi-Fi Alliance’s comments in response to the NOI demonstrated that mid-band spectrum, like the 6 GHz band, is a core component of future Wi-Fi networks which, without Commission action, will be constrained by capacity limits caused by spectrum crowding and

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<sup>2/</sup> *In the Matter of Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Notice of Inquiry, GN Docket No. 17-183 (rel. Aug. 3, 2017) (“NOI”). The Commission references the spectrum bands between 3.7 GHz and 24 GHz as “mid-band” spectrum.

technology limitations in existing bands.<sup>3/</sup> Access to the entire 6 GHz band is required to make the most of the technology that will be the basis of sixth generation Wi-Fi – 802.11ax – a standard which is already coming online.<sup>4/</sup> Because unlicensed devices, like those operated with Wi-Fi, are ideally suited to protect incumbents, designating the 6 GHz band for unlicensed use is an excellent fit for the band, which hosts a number of important services today.<sup>5/</sup>

Aside from concern from incumbents – who want to understand how their networks would be protected – there was limited opposition from only a few parties. Other commenters expressed near universal support for making 6 GHz spectrum available for unlicensed use. That support came from a joint filing of 30 unlicensed proponents,<sup>6/</sup> many of which are Part 101 license holders or Part 101 equipment manufacturers, as well as from device manufacturers – Broadcom,<sup>7/</sup> Cisco,<sup>8/</sup> Hewlett-Packard Enterprise,<sup>9/</sup> Huawei,<sup>10/</sup> Intel,<sup>11/</sup> Microsoft,<sup>12/</sup> and

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<sup>3/</sup> *Comments of Wi-Fi Alliance*, GN Docket No. 17-183, at 2 (filed Oct. 2, 2017) (“Wi-Fi Alliance Comments”).

<sup>4/</sup> *Id.* at 4.

<sup>5/</sup> *Id.* at 8.

<sup>6/</sup> *See, Comments of All Points Broadband, Amplex, Apple, Blaze, Broadcom, Cambium, Cisco, Cypress, Dell, Extreme, Facebook, Fire2Wire, Google, Hewlett-Packard, Intel, Joink, MediaTek, MediaLINK, Microsoft, NewWave, Pixius, QUALCOMM, Rise, Ruckus, Snappy, Sony, Western, WISP Association, Wisper*, GN Docket No. 17-183 at 10 (filed Oct. 2, 2017) (“All Points et. al. Comments”).

<sup>7/</sup> *Comments of Broadcom Ltd.*, GN Docket No. 17-183 (filed Oct. 2, 2017) (“Broadcom Comments”).

<sup>8/</sup> *Comments of Cisco Systems, Inc.*, GN Docket No. 17-183 (filed Oct. 2, 2017) (“Cisco Comments”).

<sup>9/</sup> *Comments of Hewlett-Packard Enterprise Company*, GN Docket No. 17-183 (filed Oct. 2, 2017) (“HPE Comments”).

<sup>10/</sup> *Comments of Huawei Technologies Co., Ltd.*, GN Docket No. 17-183 (filed Oct. 2, 2017) (“Huawei Comments”).

<sup>11/</sup> *Notice of Inquiry Comments of Intel Corporation*, GN Docket No. 17-183 (filed Oct. 2, 2017) (“Intel Comments”).

<sup>12/</sup> *Comments of Microsoft Corporation*, GN Docket No. 17-183 (filed Oct. 2, 2017) (“Microsoft Comments”).

Qualcomm.<sup>13/</sup> All agreed with Wi-Fi Alliance’s proposal to allow unlicensed operations in the full 6 GHz band. Trade groups and standards-setting bodies – CompTIA,<sup>14/</sup> the Dynamic Spectrum Alliance,<sup>15/</sup> the Wireless Broadband Alliance,<sup>16/</sup> the Wireless Innovation Forum,<sup>17/</sup> the joint filing of 30 unlicensed proponents mentioned above<sup>18/</sup> (which included the Wireless Internet Service Providers Association), as well as both the IEEE<sup>19/</sup> at large and the IEEE Dynamic Spectrum Access Networks Standards Committee<sup>20/</sup> — also generally concurred with Wi-Fi Alliance. Internet service providers such as Charter<sup>21/</sup> and the members of NCTA – The Internet and Television Association<sup>22/</sup> discussed the central role of Wi-Fi in their networks and the importance of the 6 GHz band for future operations. Even a significant operator of microwave systems in the 6 GHz band noted the merit of the proposal, provided incumbents are protected.<sup>23/</sup>

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<sup>13/</sup> *Comments of Qualcomm Incorporated*, GN Docket No. 17-183 (filed Oct. 2, 2017) (“Qualcomm Comments”).

<sup>14/</sup> *Comments of the Computing Technology Industry Association*, GN Docket No. 17-183 (filed Oct. 2, 2017) (“CompTIA Comments”).

<sup>15/</sup> *Comments of Dynamic Spectrum Alliance*, GN Docket No. 17-183 (filed Oct. 2, 2017) (“DSA Comments”).

<sup>16/</sup> *Comments of the Wireless Broadband Alliance*, GN Docket No. 17-183 (filed Oct. 2, 2017) (“WBA Comments”).

<sup>17/</sup> *Comments of the Wireless Innovation Forum*, GN Docket No. 17-183 (filed Oct. 2, 2017) (“WIF Comments”).

<sup>18/</sup> *All Points et. al. Comments*.

<sup>19/</sup> *Comments of IEEE 802*, GN Docket No. 17-183 (filed Oct. 2, 2017) (“IEEE Comments”).

<sup>20/</sup> *Comments of the IEEE Dynamic Spectrum Access Networks Standards Committee*, GN Docket No. 17-183 (filed Oct. 2, 2017) (“IEEE DSANSC Comments”).

<sup>21/</sup> *Comments of Charter Communications, Inc.*, GN Docket No. 17-183 (filed Oct. 2, 2017) (“Charter Comments”).

<sup>22/</sup> *Comments of NCTA – The Internet and Television Association*, GN Docket No. 17-183 (filed Oct. 2, 2017) (“NCTA Comments”).

<sup>23/</sup> *Notice of Inquiry Comments of the State of Maryland*, GN Docket No. 17-183 at 2 (filed Oct. 2, 2017) (“State of Maryland Comments”).

Several parties<sup>24/</sup> did not advocate for making the entire 6 GHz band available for unlicensed use, but supported opening some of the 6 GHz band for unlicensed operations. These commenters generally agreed that the lower part of the band – 5.925-6.425 GHz – should be available for unlicensed devices, provided incumbents can be protected. While Wi-Fi Alliance appreciates the recognition that some 6 GHz spectrum should be dedicated for unlicensed use, the shortage of spectrum for unlicensed operations and the scope of the applications that Wi-Fi supports today and will support in the future – validates Wi-Fi Alliance’s request that the entire 6 GHz band should be opened for unlicensed use.

Many of the commenters that are incumbent licensees in the 6 GHz band asked how unlicensed use could be introduced into the band without causing harmful interference. Wi-Fi Alliance recommends a set of proposed rules in this reply that will protect incumbents while opening the band to meaningful use by unlicensed technologies. These rule proposals have been designed to be conservative – *i.e.*, to protect incumbent users, and are premised on the currently successful rules governing unlicensed devices in the 5 GHz band. The technical proposal is discussed in Section IV below.

## **II. THE ENTIRE 6 GHZ BAND SHOULD BE AVAILABLE TO UNLICENSED OPERATIONS**

As stated in Wi-Fi Alliance’s comments,<sup>25/</sup> the entire 6 GHz band is necessary to enable Wi-Fi to continue to meet exponential growth in data demand, as well as to serve as a critical

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<sup>24/</sup> See, *Comments of CTIA*, GN Docket No. 17-183 at 15 (filed Oct. 2, 2017) (“CTIA Comments”); *Comments of the Mid-Band Spectrum Coalition*, GN Docket No. 17-183 at 4 (filed Oct. 2, 2017) (“MBSC Comments”); *Comments of T-Mobile USA, Inc.*, GN Docket No. 17-183 at 17 (filed Oct. 2, 2017) (“T-Mobile Comments”); *Comments of Verizon*, GN Docket No. 17-183 at 21 (filed Oct. 2, 2017) (“VZ Comments”); *Comments of Ericsson*, GN Docket No. 17-183 at 9 (filed Oct. 2, 2017) (“Ericsson Comments”); *All Points et. al. Comments* at 10; and *Comments of Google LLC and Alphabet Access*, GN Docket No. 17-183 at 3 (filed Oct. 2, 2017) (“Google Comments”).

<sup>25/</sup> *Wi-Fi Alliance Comments* at 4.

offload technology for 5G as envisioned by the 3rd Generation Partnership Project (“3GPP”).<sup>26/</sup>

Unlicensed devices such as Wi-Fi are ideally suited to sharing spectrum with important incumbent licensees which cannot easily be relocated; such relocation would be necessary if the same spectrum were designated for new licensed use. The experience of sharing the 5 GHz band with a variety of different users has demonstrated that the Part 15 rules that govern Wi-Fi can be adapted to ensure that this valuable spectrum is being used as efficiently as possible while protecting critical existing services.

**A. Spectrum Scarcity Requires the Allocation of the Maximum Amount of Unlicensed Spectrum Possible.**

As others recognized, Wi-Fi is the undisputed leader in getting Americans and their devices online, both as a primary connection and as off-loading for commercial wireless networks.<sup>27/</sup> Billions of devices connect to the Internet using Wi-Fi, with billions more expected to be activated in the next decade, driving incredible economic growth and improving lives. Whenever the Commission works to improve Internet access for Americans, whether via wireline or wireless networks, it must think of the needs of Wi-Fi as a crucial part of that effort.

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<sup>26/</sup> See, e.g. *HPE Comments* at 13; *Broadcom Comments* at 7; and *All Points et al. Comments* at 3.

<sup>27/</sup> See, e.g., *NCTA Comments* at 5 (“NCTA’s members [and customers of their Wi-Fi networks] supported an average of 2.5 billion active sessions, carrying 191 petabytes of data per month...these Wi-Fi networks play an important role in keeping people connected”); *HPE Comments* at 2 (“Wi-Fi is the workhorse technology...Wi-Fi is the primary technology that consumers and enterprises use to access the Internet”); *IEEE Comments* at 1 (Wi-Fi provides “benefits to many other industries and consumers as well as public institutions such as schools and hospitals that now rely heavily on Wi-Fi”); *All Points et al. Comments* at 5 (“the 2.4 GHz and 5 GHz unlicensed bands used for Wi-Fi carry more Internet data than any other wireless technology or service, with usage expected to continue increasing at a rapid pace”); and *Broadcom Comments* at 4 (“Unlicensed technologies—and Wi-Fi in particular—have generated a tremendous amount of economic value for consumers and the U.S. economy. Studies demonstrate that unlicensed technologies will contribute a total of \$547 billion to the U.S. economy in 2017 alone, and add approximately \$50 billion to the U.S. GDP”). See also, *Comments of CTIA-The Wireless Association*, ET Docket 15-105 (filed June 11, 2015) (noting that “Wi-Fi technologies have been and will continue to be an integral part of consumers’ wireless usage”); and *Comments of T-Mobile USA, Inc.*, ET Docket 15-105 (filed June 11, 2015) (noting that “Wi-Fi is a critical component of its network” and that Wi-Fi calling and texting is a function on many of its devices).

It is clear that, absent Commission action, sufficient Wi-Fi spectrum will not be available to meet growing demand. Commenters noted that the use of the 5 GHz band, which already supports unlicensed operations, has limited potential to support additional growth.<sup>28/</sup>

Wi-Fi Alliance's comments discussed the findings of its recent Spectrum Needs Study, which found that up to 1,500 megahertz of additional mid-band spectrum may be needed by 2025, and that it is important that as much of that spectrum as possible be positioned to allow for the wide channels that will be used by devices operating on 802.11ax technology.<sup>29/</sup> Other commenters noted the worsening spectrum shortfall as well. Broadcom called additional mid-band spectrum "critical to addressing the unlicensed spectrum crunch;"<sup>30/</sup> Hewlett-Packard Enterprise ("HPE") noted that Wi-Fi "will soon run out of spectrum," citing to studies conducted by Cisco and Quotient, and noting that no additional mid-band spectrum has been made available for unlicensed use in nearly 20 years;<sup>31/</sup> the Wireless Broadband Alliance noted "a profound and growing need for additional designations of mid-band spectrum for unlicensed operations;"<sup>32/</sup> and a coalition of companies from diverse industries noted that the 540 megahertz of spectrum allocated for Wi-Fi carries the vast majority of Internet traffic, and is facing serious crowding.<sup>33/</sup>

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<sup>28/</sup> See, *IEEE Comments* at 2 (The lack of unlicensed access to the full 5GHz band, as originally intended, "has forced a whole rethinking of the future of those applications and the industry, as well as those that depend on it"); *Broadcom Comments* at 8 ("The Commission's recent decision, in consultation with [NTIA to not open the U-NII-2B band] closed off one of the few remaining avenues for expanding unlicensed mid-band spectrum, other than through this NOI"); and *DSA Comments* at 12 ("This is particularly important now that the Commission has announced that it will not open the U-NII-2B band for unlicensed broadband operations. Industry has been preparing for this band since the Commission issued its 2013 NPRM on the U-NII bands").

<sup>29/</sup> *Wi-Fi Alliance Comments* at 5.

<sup>30/</sup> *Broadcom Comments* at 25.

<sup>31/</sup> *HPE Comments* at 2.

<sup>32/</sup> *WBA Comments* at 7.

<sup>33/</sup> *All Points et al. Comments* at 5.



Because of this recognized spectrum shortage, and the lack of progress in other bands, it is vital that as much mid-band spectrum as possible be made available for unlicensed use. It is equally important that access is provided *quickly* to avoid delaying efforts at improving existing networks and enabling critical new technologies ready to be introduced now and in the near future.

Some commenters argued that only one of the 5.925-6.425 GHz and 6.425-7.125 GHz bands be designated for unlicensed use.<sup>34/</sup> Wi-Fi Alliance strongly disagrees. As noted above, there is a desperate and growing need for more unlicensed mid-band spectrum, and allocating the 6 GHz band's full 1200 megahertz to this use is vital to making a meaningful and long-term impact on spectrum shortfalls. Even if the Commission were to, in the future, find other mid-band spectrum for Wi-Fi, many of the benefits of access to the entire 6 GHz band would not apply (in particular, nearly contiguous access to 2 gigahertz of spectrum, when the 5 GHz band is included). 802.11ax, the future of Wi-Fi, requires access to contiguous spectrum for implementation of wider channels. Curtailed spectrum would limit Wi-Fi's ability to deliver maximum benefits of the broadband wireless connectivity.<sup>35/</sup>

## **B. The Scope of Uses of Unlicensed Spectrum Has Expanded**

Several commenting parties that are incumbent microwave users in the 6 GHz band note the critical nature of their operations.<sup>36/</sup> Wi-Fi Alliance agrees, which is why it has asserted that

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<sup>34/</sup> See *MBSC Comments* at 4; *Verizon Comments* at 21; *T-Mobile Comments* at 17; *Ericsson Comments* at 9; and *Google Comments* at 3.

<sup>35/</sup> See, *IEEE Comments* at 5; and *Qualcomm Comments* at 4.

<sup>36/</sup> See, e.g., *Comments of Comsearch*, GN Docket No. 17-183 at 2 (filed Oct. 2, 2017); *Comments of Duke Energy Corporation*, GN Docket No. 17-183 at 1 (filed Oct. 2, 2017); *Comments of the Fixed Wireless Communications Coalition*, GN Docket No. 17-183 at 1 (filed Oct. 2, 2017) ("FWCC Comments"); and *Comments of the National Spectrum Management Association*, GN Docket No. 17-183 at 5 (filed Oct. 2, 2017) ("NSMA Comments").

those incumbent operations should continue unaffected by Wi-Fi access to this spectrum, rather than be relocated. Nevertheless, in evaluating spectrum use, the Commission must recognize that critical services aren't provided on licensed frequencies alone – Wi-Fi also supports important public safety and related applications. Making additional spectrum for Wi-Fi and other unlicensed technologies is in the public interest, just as the Commission must ensure that licensed services continue to have sufficient spectrum to support public safety needs.

In fact, unlicensed networks are now responsible for delivering a substantial amount of non-critical traffic for important public safety operations. Smart cities are being built on unlicensed networks, many of them Wi-Fi networks;<sup>37/</sup> government operations rely on unlicensed networks to connect infrastructure and coordinate operations, including those involving public safety; and hospitals utilize a variety of unlicensed networks to connect doctors and nurses with patients and to get data from devices to providers, improving care and reducing healthcare costs.<sup>38/</sup> In sum, unlicensed networks are increasingly being used both indoors and outdoors to enable any number of public benefits.

And Wi-Fi accomplishes all of this without the protections or guaranteed spectrum access of a licensed service. Section 15.5 of the Commission's Rules, which requires unlicensed devices to accept and to not cause interference, continues to apply to these devices, even when operating in a public safety role.<sup>39/</sup> Accordingly, industries that rely on microwave and other

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<sup>37/</sup> See, Wi-Fi Alliance, *Wi-Fi and the Rise of Smart Cities*, Oct. 30, 2015, available at <https://www.wi-fi.org/beacon/kevin-robinson/wi-fi-and-the-rise-of-smart-cities>.

<sup>38/</sup> See, SecurEdge Networks, *Re-Thinking Healthcare: 5 Must-Know Hospital Wi-Fi Trends*, Dec. 11, 2015, available at <https://www.securedgenetworks.com/blog/re-thinking-healthcare-5-must-know-hospital-wifi-trends-infographic>; and Wi-Fi Alliance, *Discover Wi-Fi: Healthcare*, available at <https://www.wi-fi.org/discover-wi-fi/healthcare>.

<sup>39/</sup> 47 C.F.R. § 15.5.

licensed services also rely on Wi-Fi, and ensuring Wi-Fi's viability by providing adequate access to spectrum on non-interference basis is also critical to their important work.

### **III. UNLICENSED OPERATIONS CAN SHARE SPECTRUM WITH INCUMBENTS**

A number of commenters emphasized the ability of unlicensed operations to co-exist with incumbent users, protecting them from interference while making the most of valuable spectrum.<sup>40/</sup> For example, IEEE 802 Committee noted that 6 GHz incumbent protection mechanisms being proposed will be “as effective as DFS has been.”<sup>41/</sup> Intel agreed, observing that this band is “conducive to Part 15 unlicensed broadband use for applications such as Wi-Fi.”<sup>42/</sup> The Dynamic Spectrum Alliance stated that the 6 GHz band is “ideal for unlicensed use” and that “unlicensed [use] can provide necessary protections for incumbents across the band.”<sup>43/</sup> Broadcom provided an extensive technical analysis of incumbent use and sharing mechanisms in different parts of the 6 GHz band, concluding that the Commission “should issue an NPRM...to enable unlicensed broadband operations” in the 6 GHz band.<sup>44/</sup>

As these commenting parties point out – and in contrast to licensed services – no relocation of incumbent operations or repurposing of spectrum would be required to accommodate unlicensed access by Wi-Fi in the 6 GHz band. In particular, as many commenters noted, relocation of microwave operations out of this band would be difficult and expensive, and

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<sup>40/</sup> See, e.g., *Broadcom Comments* at 8; *Cisco Comments* at 5; *HPE Comments* at 8; *Huawei Comments* at 9; and *IEEE DSANSC Comments* at 2.

<sup>41/</sup> *IEEE Comments* at 3.

<sup>42/</sup> *Intel Comments* at 5.

<sup>43/</sup> *DSA Comments* at 12.

<sup>44/</sup> *Broadcom Comments* at 25.

may not be an option at all for the many operators that rely on the unique properties of the band.<sup>45/</sup>

For example, CenturyLink noted that moving to higher frequencies would involve dramatic increases in cost for existing networks, since these frequencies require shorter distances between each antenna.<sup>46/</sup> The National Public Safety Telecommunications Council detailed the move from 2 GHz to 6 GHz, which many of these operations already experienced, and explained why doing so again would be “very detrimental to public safety and the public it serves.”<sup>47/</sup>

The Commission should also reject requests to designate any or all of the 6 GHz band for fixed point-to-multipoint use.<sup>48/</sup> Those systems rely on proprietary technology that does not enjoy the same adoption as technologies such as Wi-Fi, and those developed by 3GPP, that today enjoy widespread use. Unlicensed operations are a better use for this spectrum. As the Commission has recognized, the unlicensed ecosystem is today delivering enormous public benefits at all levels of the nation’s economy. Wi-Fi Alliance believes it is a far more compelling use of 6 GHz to promote the ability of the unlicensed ecosystem to continue to grow and thrive. The 6 GHz band, moreover, is the first and best alternative for unlicensed use, as it is adjacent to existing unlicensed bands and is not encumbered by Federal uses.

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<sup>45/</sup> *FWCC Comments* at 12; *Comments of the Utilities Technology Council and the Edison Electric Institute*, GN Docket No. 17-183, at 8 (filed Oct. 2, 2017) (“UTC/EEI Comments”); *Comments of APCO International*, GN Docket No. 17-183 at 4 (filed Oct. 2, 2017); and *WIF Comments* at 4.

<sup>46/</sup> *Comments of CenturyLink*, GN Docket No. 17-183 at 2 (filed Oct. 2, 2017) (“Centurylink Comments”).

<sup>47/</sup> *Comments of the National Public Safety Telecommunications Council*, GN Docket No. 17-183 at 5 (filed Oct. 2, 2017).

<sup>48/</sup> *Comments of Frontier Communications Corporation, Windstream Services, LLC, and Consolidated Communications, Inc.*, GN Docket No. 17-183 at 7 (filed Oct. 2, 2017); *Google Comments* at 13; *Comments of California Internet, LP dba Geolinks*, GN Docket No. 17-183 at 1 (filed Oct. 2, 2017); and *Comments of NetMoby*, GN Docket No. 17-183 at 6 (filed Oct. 2, 2017).

Although some operators of microwave systems in the 6 GHz band questioned how unlicensed devices could effectively share spectrum with their systems, others have indicated unlicensed use is possible,<sup>49/</sup> and years of operational experience in the 5 GHz band have shown that Wi-Fi technology can share with a diverse set of incumbent technologies, using a wide range of Part 15 mitigation techniques to protect incumbent services.<sup>50/</sup> These mitigation techniques – including modified or entirely new ones – can protect incumbent services in 6 GHz band. This reply contains such a proposal, including enforcement mechanisms. As it does with devices required to incorporate Dynamic Frequency Selection (“DFS”) in the 5 GHz band, the Commission can ensure compliance with interference mitigation requirements in the 6 GHz band through the equipment authorization process.

A few commenters assert that incumbents’ operations are so sensitive that sharing is impossible; some argued that, even without direct interference from a particular unlicensed network, simply allowing unlicensed operations at all would raise the noise floor and reduce operational effectiveness.<sup>51/</sup> Wi-Fi Alliance appreciates the critical nature of the traffic carried on microwave networks and agrees they should be protected from harmful interference. As discussed above, however, allowing unprotected unlicensed operations in these bands used by microwave networks is perfectly calibrated to achieve the Commission’s twin goals of incumbent protection and additional spectrum for mobile broadband.

Moreover, claims that microwave systems will suffer because of an increase in the noise floor created by unlicensed operations in the same band are unsupported. The issue is not

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<sup>49/</sup> See, e.g., *All Points et al. Comments* at 10; *State of Maryland Comments* at 2.

<sup>50/</sup> *IEEE Comments* at 3; and *NCTA Comments* at 5.

<sup>51/</sup> See, e.g., *UTC/EEI Comments* at 12; *NSMA Comments* at 13; and *Comments of Lower Colorado River Authority*, GN Docket No. 17-183 at 4 (filed Oct. 2, 107) (“LCRA Comments”).

whether the noise floor changes: the issue is whether harmful interference results. The proposal provided in this reply will ensure that links in the FCC licensing databases will continue to be available. More fundamentally, uncritical preservation of the status quo is not an option in the world of spectrum scarcity, and is contrary to the public interest.

#### **IV. A PROPOSED FRAMEWORK FOR INCUMBENT PROTECTION**

Wi-Fi Alliance supports the Commission's proposal to expand the rules governing U-NII devices under Part 15 rules to the 6 GHz band.<sup>52/</sup> The experience of sharing the 5 GHz band with a variety of different users has demonstrated that the Part 15 rules that govern Wi-Fi can be adapted to ensure that this valuable spectrum is being used as efficiently as possible while protecting critical existing services. The Commission's Part 15 rules are specifically intended to ensure no harmful interference is caused to any other authorized operations.<sup>53/</sup>

The nomenclature suggested by IEEE matches the type of interference mitigation required for different segments of the 6 GHz band, and segmenting the band would be consistent with how the Commission has approached incumbent protection in the 5 GHz band. In particular, IEEE has recommended the following nomenclature for the 6 GHz band:<sup>54/</sup>

U-NII-5 – 5.925-6.425 GHz  
U-NII-6 – 6.425-6.525 GHz  
U-NII-7 – 6.525-6.875 GHz  
U-NII-8 – 6.875-7.125 GHz

The proposed protection mechanisms discussed below, which address concerns raised by commenters,<sup>55/</sup> follow these designations.

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<sup>52/</sup> See, *NOI* at ¶¶ 29 and 36.

<sup>53/</sup> See 47 C.F.R. § 15.5

<sup>54/</sup> See, *IEEE Comments* at 3; *Broadcom Comments* at 11; *HPE Comments* at 9; *All Points et al. Comments* at 12; and *WBA Comments* at 21.

<sup>55/</sup> See, e.g., *FWCC Comments* at 6; *UTC/EEI Comments* at 6; *Comments of the Satellite Industry Association*, GN Docket No. 17-183 at 5 (filed Oct. 2, 2017) ("SIA Comments"); and *Comments of*

The proposal reflects several goals. *First*, that the mitigation mechanisms protect incumbent operations. *Second*, that unlicensed operations in the 6 GHz band are an extension of the 5 GHz band; for IEEE 802.11 technology, Wi-Fi Alliance expects that 802.11ax will be the technology that spans these bands. In order to realize economies of scale, some of the basic technical parameters for 5 GHz operation should be extended into the 6 GHz band, and that is reflected in the proposal below.<sup>56/</sup> As an additional consequence of considering 6 GHz as an extension of 5 GHz, Wi-Fi Alliance has proposed that the Commission designate the 6 GHz band using the nomenclature noted above. *Finally*, the goal of the mitigation techniques proposed is not simply to protect incumbents, but also to ensure that the 6 GHz rules unlock the economic benefits of unlicensed technologies.

#### **A. Classes and Bands Summary**

To make the best use of 6 GHz, Wi-Fi Alliance proposes five classes of U-NII devices that will operate in the following U-NII bands:

	U-NII-5	U-NII-6	U-NII-7	U-NII-8
Indoor Access Points and other Indoor Fixed Devices	X	X	X	X
Client Devices	X	X	X	X
Outdoor Low Power Devices	X		X	X*
Outdoor Access Points and Point to Multipoint Devices	X		X	X*
Outdoor Fixed Point-to-Point, and Steerable Point-to-Point Devices	X		X	X*

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*American Association of State Highway & Transportation Officials*, GN Docket No. 17-183 at 3 (filed Oct. 2, 2017).

<sup>56/</sup> For example, utilizing U-NII type rules ensures that manufacturers can work with existing test houses in bringing equipment forward for certification.

\*As discussed further below, outdoor operations may be possible in the U-NII-8 band, but this issue requires further study.

**B. Devices and Mitigations.**

Under the Part 15 regime, devices must satisfy particular FCC rules and requirements for operations in an unlicensed band. For the 6 GHz band, Wi-Fi Alliance proposes the following classes of devices and mitigation mechanisms. As is the case today, before equipment can enter the market, compliance testing must be developed, and equipment tested against those compliance requirements. Wi-Fi Alliance does not offer compliance test suggestions here, but looks forward to working with the Commission and interested parties to develop those tests in the future.

**1. Indoor Access Points and Other Fixed Indoor Devices**

Indoor Access Points and Other Fixed Indoor Devices would include, for example, set top boxes and game consoles. As noted above, the proposed rules for these devices would apply consistently across all the newly-designed U-NII bands. This class of devices borrows the concept already articulated in Section 15.257(a) of the rules, which embraces the notion that devices designed exclusively for indoor use, and connected to an indoor power source (such as an AC power line) can be certificated for indoor only operation. Indoor access points and fixed devices should be limited to a maximum conducted output power consistent with that currently established for Indoor Access Points in UNII-3,<sup>57/</sup> unless the Commission has reason to relax or restrict certain parameters based on technical analysis. This would protect incumbent operations and maximize deployment of unlicensed devices. The conducted power limits for U-NII-3 are appropriate because an indoor device presents limited interference potential – the device’s signal

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<sup>57/</sup> See, 47 C.F.R. § 15.407(a)(3).



is significantly contained within a building's walls. Attenuation from drywall, wood, concrete, metal, glass, brick, or other forms of durable, dense material block the signal and reduce its interference potential.<sup>58/</sup> For indoor access points and indoor fixed devices, transmit power control ("TPC") would also apply, which ensures that devices have the capability to operate at levels 6 dB below the regulatory limit.

## **2. Client Devices.**

Client Devices are a class of device that operates at the direction of a master device – normally an access point. Like the indoor devices noted above, client devices would operate across all U-NII bands. Because these devices operate using batteries, they are sensitive to power consumption. As a result, they operate at significantly lower power, meaning they present a substantially reduced interference risk. Hence, the interference potential of these devices can be managed by the Commission simply by establishing appropriate limits on conducted output power and antenna gain. More specifically, client devices should be limited to output power roughly consistent with that currently established for client devices in the U-NII-1 band, unless the Commission finds reason to relax or limit certain parameters based on technical analysis.<sup>59/</sup> As above, transmit power control would also apply to this class of devices.

## **3. Low Power Outdoor Access Points.**

In recent years, a wide range of organizations that depend on Wi-Fi indoors have deployed short-range, limited footprint coverage adjacent to their buildings to provide a consistent experience when users move outside. Examples include restaurant patios, garden centers, warehouse loading docks, hotel and apartment building pool areas, stadiums, school

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<sup>58/</sup> See, Recommendation ITU-R P.452-16. Prediction procedure for the evaluation of interference between stations on the surface of the Earth at frequencies above about 0.1 GHz. The interference potential would be further reduced by the clutter loss.

<sup>59/</sup> 47. C.F.R. § 15.407(a)(1)(iv).

campuses, police vehicle or municipal transit parking lots, and hundreds, if not thousands, of other types of spaces adjacent to indoor operations. These users are characterized by comparatively short range, low gain omnidirectional or wide sector antenna patterns, and mounting heights below the roofline. This is distinct from high power deployments by businesses or service providers intended to provide pervasive, engineered, high carrier-to-noise (“C/N”) ratio coverage across a large area. Because those higher power deployments will be subject to more intrusive mitigation requirements that involve higher costs and complexity, it is essential to create a “safe harbor” for organizations that have limited outdoor coverage needs that protects incumbents without creating incentives to deploy that indoor equipment outside.

Therefore, Wi-Fi Alliance proposes that the Commission permit operation of low power outdoor access points designed for deployment that, due to power levels and other constraints, would have limited range. These devices would operate in U-NII-5, U-NII-7 and, subject to further study, in the U-NII-8 bands.

Low Power Outdoor Access Points would be permitted to operate with a maximum conducted output power lower than conventional Indoor and Outdoor Access Points by at least 6 dB, based on the results of sharing studies. Low-Power Outdoor Access Points would also be limited to lower-gain antennas suitable for short-range, wide-angle coverage. Moreover, the rules should limit the height of the transmitter, recognizing the above-ground height of common garden center or warehouse installations. TPC rules should also apply to these devices.

This proposal will protect incumbents by providing an affordable but constrained path for users with legitimate near-field outdoor requirements to meet their needs without burdening them with the costs of operating higher power equipment. The dramatically reduced power level of these devices will ensure that the use case envisioned is the one that will be deployed. As an

extension of an indoor system, the coverage area will be immediately adjacent to a building. Moreover, the permitted power would be too low and the antenna gain too limited to efficiently use these devices to cover large areas.

The use of Low Power Outdoor devices may be possible in the U-NII-8 band, but further study is required. There are a variety of possible mitigation techniques that could apply to protect incumbent users in the band. Protection of U-NII-8 licensees may require mitigation mechanisms that are not required to protect incumbents in the U-NII-5 and U-NII-7 bands. While Wi-Fi Alliance does not propose specific mitigation techniques here, it requests that additional study be conducted in connection with the Notice of Proposed Rulemaking (“NPRM”) in this proceeding. In particular, it suggests that the Commission ask the following in the NPRM:

- Do the incumbent fixed use cases in the U-NII-8 band present any unique challenges compared to U-NII-5 or U-NII-7 bands?
- Some of the incumbent license classes present deployment models where a transmitter is not in a permanent fixed location, such as the broadcast auxiliary service (“BAS”). How are these classes of transmitters typically used?
- There appear to be local links, longer-distance links and satellite links in the U-NII-8 band. What mix of technologies are typically used and how are these radio links characterized?
- Within the BAS, it appears that Television Pick Up is the most mobile in terms of use cases. Are there other services that are also similarly mobile?
- Are there any techniques or capabilities that U-NII manufacturers can utilize to reduce the dependency of operation in any single U-NII band, such as U-NII-8?

#### **4. Outdoor Access Points and Fixed Point-to-Multipoint Devices.**

These devices should be permitted in the U-NII-5, U-NII-7, and, subject to further study, U-NII-8 bands. As with low power access points, no outdoor operations would be permitted in the U-NII-6 band. Outdoor access points and fixed point-to-multipoint devices should be limited to a maximum conducted output power and other rules similar to UNII-1. However, Wi-Fi Alliance recognizes that the risk of interference from this class of devices is naturally higher. For this reason, Wi-Fi Alliance proposes the following mitigation requirements. *First*, this class

of device must be professionally installed. *Second*, installers and operators would be required to ensure that the devices are not pointing with 2 degrees of the geostationary arc, a concept that already exists in Section 101.145 of the rules.<sup>60/</sup> Importantly, the protections in the Part 101 rules assume a much higher power level than what Wi-Fi Alliance proposes for Outdoor Access Points. *Third*, the Commission should incorporate an elevation mask based on the U-NII-1 rules, limiting the maximum EIRP at any elevation angle above 30 degrees above the horizon, but increasing the allowable EIRP in recognition that the FSS operations in 6 GHz operate higher in higher orbits, as opposed to the LEO satellites in U-NII-1.

In addition, for bands where outdoor unlicensed use is allowed in the 6 GHz band, the Commission should require the use of an automated mechanism to determine whether individual unlicensed outdoor access points can transmit from a given location and on a given frequency based on the presence of fixed incumbents. Outdoor access points or the networks that control them would be required to initially and periodically query such a system to determine which channels are available at the relevant location. The automated interference protection mechanism would be informed by, or might be, the FCC's own licensing databases – including licensing information compiled pursuant to Parts 25, 74, 78, and 101 – or they might be third party services. In addition, the mechanism would be required to apply the appropriate protection criteria to ensure that unlicensed operations are sufficiently removed from the incumbent. Given the infrequent nature of license changes in these sub-bands, outdoor access points should only be subject to a monthly look-up requirement to ensure that unlicensed devices have current information.

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<sup>60/</sup> 47 C.F.R. § 101.145.

The interference protection mechanism must also be sufficient to protect licensees in the U-NII-8 band against interference from any outdoor unlicensed use. As discussed with respect to low power outdoor devices, the Commission should pose questions in the record that will support further analysis of the U-NII-8 sharing opportunity. In addition to the questions above, the Commission should ask if an exclusion zone surrounding any fixed/steerable receiver listed in the ULS or Cable Operations and Licensing System database could be sufficient to help mitigate possible interference to U-NII-8 licensees.

Outdoor access point beacons should also broadcast unique identifying information, including a geolocation tag, for all the reasons stated above. These devices would also be subject to the TPC rule.

**5. Fixed and Steerable Point-to-Point and Outdoor.**

Unlicensed operation of several types of fixed devices that utilize highly directionalized signals should also be permitted in the U-NII-5, U-NII-7 and, subject to further study, U-NII-8 bands consistent with those currently established for client devices in the U-NII-3 band, unless the Commission finds reason to relax or limit certain parameters based on technical analysis. All of the mitigations that apply to Outdoor Access Points – professional installation, avoidance of the satellite arc, elevation mask, interference protection mechanism, identifying information and TPC – should apply. The Commission should propose to authorize point-to-point and steerable point-to-point operations for outdoor fixed use. A steerable point-to-point device uses multiple antenna elements to transmit data to multiple receivers using one or more highly directional steerable beams transmitting to one station at a time. With respect to potential U-NII-8 outdoor operation, the questions posed above with respect to low power and outdoor access points should yield information sufficient for further analysis.

C. **Satellite Operations.**

Years of operational experience in U-NII-1 band confirm that those rules should be more than sufficient to protect the FSS uplink operations. FSS operations in U-NII-1 band are in non-geostationary, lower-earth orbit, while FSS uplink operation in the 6 GHz band are at a much-higher, geostationary orbit – providing for significantly more separation, and therefore interfering signal attenuation, between U-NII transmitters and satellite receivers. As these protections have proved to be effective in limiting interference to low-Earth orbiting satellites in the U-NII-1 band, then certainly they will be able to provide sufficient interference avoidance to the geostationary satellite receivers in 6 GHz. In addition, similar to Part 101 requirements, U-NII antennas in the 6 GHz band must be subject to a pointing limitation in order to avoid the geostationary satellite orbit. To avoid interference to the FSS receiving earth stations, U-NII devices employing geolocation capability will cease transmission within a defined exclusion zone on frequencies authorized to that station.

D. **Adjacent Band Protection - Emission Limits.**

In order to protect operations in adjacent bands, both within and outside the 6 GHz band, from interference from U-NII operations in this band, the Commission should impose the same out-of-band emission limits as those currently applicable to the U-NII-3 band.<sup>61/</sup> These protections have proven effective in the 5 GHz band, and will provide sufficient protection for the 6 GHz band.

E. **Additional Database Considerations**

A key component of mitigation proposal for outdoor access points and point-to-point operations is to ensure that the ULS and other Commission license databases are accurate. As

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<sup>61/</sup> 47 C.F.R. § 15.407(b)(4).

Wi-Fi Alliance noted in its initial comments,<sup>62/</sup> there are concerns with existing ULS entries, and other commenters noted similar concerns with ULS and other Commission databases.

The Commission should therefore ensure that its licensing databases are accurate by issuing a Public Notice requiring that licensees affirm current operations including all technical parameters of the transmitters and receivers, or modify licenses to reflect existing use. Failing to respond would result in a notation in ULS that the licensed operations do not require protection. Of course, licensees would be permitted to remove this “no protection” restriction at any time by affirming existing operations or modifying their license to reflect current use.

In addition, several comments, without specific reference to 6 GHz, generally discuss the use of a Spectrum Access System (“SAS”), like that now mandated for the 3.55-3.7 GHz band. The SAS in the 3 GHz band exists in the context of a tiered access structure where access to spectrum could change dynamically and instantaneously, due to governmental radar operations. Persistent connection to the SAS is required, as is the necessity of providing information to the SAS about operations in the priority tier or the general tier. These complexities, and the SAS design in response to them, are not present in 6 GHz. Therefore, outdoor access point and point-to-point operations simply requires the unlicensed system to request available channels at a given geography.

**V. OTHER MATTERS RAISED BY COMMENTING PARTIES SHOULD NOT DELAY DESIGNATION OF THE 6 GHZ BAND FOR UNLICENSED USE.**

**A. Illegal Modification of Wi-Fi Devices.**

Tucson Power alleged that unlicensed equipment can be illegally modified and cause interference issues.<sup>63/</sup> Illegal modification of equipment is always a possibility, and

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<sup>62/</sup> *Wi-Fi Alliance Comments* at 8.

<sup>63/</sup> *See, Comments of Tucson Electric Power Company*, GN Docket No. 17-183 at 6 (filed Oct 2, 2017).

manufacturers will work diligently to prevent any alterations which increase interference risks. The Commission has designed its rules to address the potential modification of U-NII band equipment, and the same limitations can apply to the 6 GHz band.<sup>64/</sup> Moreover, unauthorized operations occur in licensed spectrum as well. The Commission should not limit deployment of legal devices as a reaction to limited impermissible operations. Instead, it should focus on rigorous enforcement efforts where appropriate.

**B. Undesirable Emission Limits**

Commenters representing manufacturers of automobiles pointed to the (long-delayed) future deployment of Dedicated Short-Range Communications (“DSRC”) equipment in the 5.9 GHz band and noted possible interference issues.<sup>65/</sup> The Commission need not evaluate necessity of any guard band between 6 GHz band U-NII operations and 5.9 GHz DSRC at this time. Instead, the Commission should establish appropriate undesirable emission limits for the U-NII operations in the 6 GHz band. The 5 GHz U-NII Part 15 rules provide excellent precedent. Consistent with Section 15.407(b) of the rules, the maximum emissions limit outside of the frequency bands of operations applies to all 5 GHz bands including U-NII-3, which is immediately adjacent to the 5.9 GHz band.<sup>66/</sup> In light of previous decisions, there is no reason to regulate unwanted out of band radiation from U-NII devices any differently in 6 GHz band than in 5 GHz band. Moreover, considering the intended goal of expanding spectrum access to U-NII devices, there is a significant benefit to maintaining regulatory uniformity.

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<sup>64/</sup> See, e.g., 47 C.F.R. §§ 15.21; 15.121; 15.204; and 15.243.

<sup>65/</sup> See, *Comments of Association of Global Automakers*, GN Docket No. 17-183 at 2 (filed Oct. 2, 2017); and *Comments of the Alliance of Automobile Manufacturers*, GN Docket No. 17-183 at 2 (filed Oct. 2, 2017).

<sup>66/</sup> See, *In the Matter of Revision of Part 15 Rules to Permit Unlicensed National Information Infrastructure Devices in the 5 GHz Band*, 29 FCC Rcd. 4127 ¶ 120 (2014).



### **C. Use of DFS Bands**

Some commenters claimed that lower utilization of Part 15 devices in DFS-bands indicates that 6 GHz bands which fully protect incumbents will be underused.<sup>67/</sup> In fact, the relatively lower utilization of these bands is a sign that unlicensed network operators have not yet been able to take full advantage of these rules because of their unique requirements,<sup>68/</sup> and the Commission's request in this proceeding for more information is a sign that it recognizes that the DFS equipment authorization program can be reformed to reach its maximum potential. The lessons learned in these efforts, both by the Commission and industry, can be applied to maximizing the non-interfering operations in the 6 GHz band. For now, the most important data from DFS implementation is the lack of interference issues in DFS bands: this shows that the system is fully capable of protecting incumbents, and it can do so in the 6 GHz band as well.<sup>69/</sup>

### **VI. THE COMMISSION SHOULD ISSUE AN NPRM FOR THE 6 GHZ BAND QUICKLY**

Wi-Fi Alliance urged the Commission to move quickly to adopt an NPRM specifying rules that would govern unlicensed use of the 6 GHz band. Others agreed. The Mid-Band Spectrum Coalition, for example, noted that its members believe "prompt action by the Commission is essential;"<sup>70/</sup> HPE pointed to the United States' leadership on Wi-Fi and stated that, with 5G on the horizon and mid-band spectrum playing a crucial role, "we need to act now. The alternative is increased congestion and degraded consumer experiences"<sup>71/</sup> The comments

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<sup>67/</sup> See, e.g., *Comments of United States Cellular Corporation*, GN Docket No. 17-183 at 6 (filed Oct. 2, 2017); and *NPSTC Comments* at 9.

<sup>68/</sup> See, e.g., *Comments of Wi-Fi Alliance*, ET Docket No. 17-215 at 2 (filed Oct. 30, 2017).

<sup>69/</sup> *Huawei Comments* at 10; *WBA Comments* at 11; and *Comments of Vivint Wireless Inc.*, GN Docket No. 17-183 at 4 (filed Oct. 2, 2017).

<sup>70/</sup> *MBSC Comments* at 13.

<sup>71/</sup> *HPE Comments* at 14.

filed by a broad coalition of industry participants urged the Commission to “expeditiously” move towards an NPRM,<sup>72/</sup> and the IEEE 802 Committee noted the urgency of the need and asked for action “as soon as possible.”<sup>73/</sup> The Commission should follow this broadly held view, and expedite its consideration of the issues raised in this proceeding, with the goal of issuing an NPRM in the first quarter of 2018.

## VII. CONCLUSION

As demonstrated above, the need for spectrum capacity for unlicensed use is severe. Over the last 20 years, the amount of spectrum for licensed access below 8 GHz has increased several fold,<sup>74/</sup> while spectrum made available for unlicensed use has remained virtually unchanged. In addition to severe capacity constraints and lack of additional spectrum, devices capable of taking advantage of this spectrum are already becoming available; there can be no delay. 802.11ax is the future of Wi-Fi, and the future is already here; failure to act quickly will only delay the opportunities this technology presents to all Americans.

Wi-Fi Alliance therefore commends the Commission for its forward-thinking efforts in this proceeding. The Commission should now quickly act on the record in this proceeding, which includes detailed suggestions on protection and interference mitigation mechanisms, and expeditiously move towards an NPRM that will allow unlicensed operations in this band while protecting incumbent operations.

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<sup>72/</sup> *All Points et al Comments* at 22.

<sup>73/</sup> *IEEE Comments* at 4.

<sup>74/</sup> *See, e.g., In the Matter of Expanding the Economic and Innovation Opportunities through Incentive Auctions*, Report and Order, 29 FCC Rcd. 6567 (2014); *Promoting Interoperability in the 700 MHz Commercial Spectrum*, Report and Order, 28 FCC Rcd 15122 (2013); and *Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands*, Report and Order, 18 FCC Rcd 25162 (2003).

RESPECTFULLY SUBMITTED,

A handwritten signature in black ink, appearing to read 'Edgar Figueroa', with a stylized flourish at the end.

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November 15, 2017